ALUMINUM

Project Fact Sheet

WETTED CATHODES

BENEFITS

The potential benefits of this project include:

- reducing primary aluminum production energy consumption by up to 30 percent
- eliminating, CO, CO_2 and PFC emissions
- eliminating spent potliner solid waste
- reducing capital and operating costs

APPLICATIONS

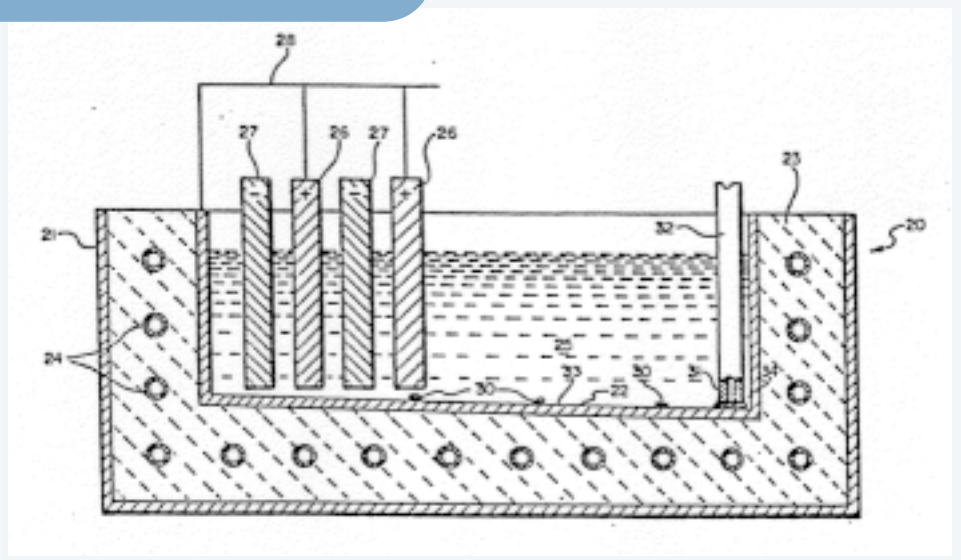
This project will provide economic benefit both to the end-use aluminum smelting industry and to the supply-side materials industry.

WETTED CATHODES FOR LOW TEMPERATURE ALUMINUM SMELTING

Wetted cathodes and inert anodes have potentially significant advantages over the century old Hall-Heroult cell used today for worldwide aluminum production. Wetted cathodes allow for decreased anode-cathode distances accompanied by reduced voltages and energy consumption. Inert anode replacement of conventional carbon anodes will eliminate the emission of greenhouse gases associated with the production of primary aluminum (e.g., CO, CO_2 and perfluorocarbons) and with the manufacture of the carbon anodes. The use of wettable cathodes with inert anodes could reduce the energy needed for primary aluminum production by 25 to 30 percent. The adoption of these advanced electrodes has been hindered by their rapid corrosion, particularly of the cathode, when operating at a conventional temperature of 950°C.

A low temperature electrolysis (LTE) cell which operates about 200°C lower than a conventional cell offers a more benign environment for advanced electrodes. This project will extend the knowledge of wetted cathode operation and failure mechanisms. It will prepare and screen various wetted cathode materials for aluminum LTE cells and develop techniques to measure and evaluate the aluminum film on the wetted cathode. Successful development of this technology will lower both capital and operating costs and offer many advantages in energy and environmental conservation.

WETTED CATHODES



Vertical electrode low temperature aluminum smelting cell with wetted cathodes and inert metal anodes (T.R. Beck & R.J. Brooks, U.S. Patent No. 5,284,562 [1994]).

Project Description

Goals: The goals are to develop, test, and demonstrate a suitable wetted cathode material for low temperature electrolysis (LTE) smelting applications. In meeting these goals, the objectives of this project are to:

- Develop and fabricate formulations of candidate cathode materials.
- Develop procedures for evaluating the aluminum film contiguity on wettable cathode surfaces.
- Test wetting, aluminum film contiguity and cathode corrosion rates of a range of wettable materials, under a range of conditions.
- Obtain consistent contiguous aluminum film coverage of wetted cathode on all exposed surfaces.
- Obtain consistent low cathode corrosion rates and statistically validated results equal or better than the best results produced to date.
- Model the cathode environment under LTE conditions.
- Evaluate cathode performance under conditions of the LTE process.

Progress and Milestones

Each industrial partner will perform work appropriate to its expertise in completing this project. Successful development of the wetted cathode technology will require the following steps:

- Complete the current R&D effort including proving the integrity of the cathode material and the feasibility of scale-up.
- Implement the cathodes in an operating laboratory cell over a long enough period to verify the operating parameters such as current efficiency and power consumption.
- Develop parameters and criteria for the construction and operation of the plant prototype.

Materials Modification, Incorporated (MMI)

- Analyze powders of TiB_2, TiB_2 composites, and ZrB_2 for particle size distribution, composition and particle shape.
- Perform consolidation using Plasma Pressure Compaction (P^2C™) and hot pressing to provide a comparison of the effect of consolidation techniques on the electrochemical behavior.
- Evaluate consolidated cathode specimens for density, composition, and microstructure.

Northwest Aluminum Technologies (NAT)

- Investigate and develop methods for measuring aluminum film contiguity.
- Test different cathode materials.
- Investigate the inter-granular corrosion phenomenon.
- Model the cathode environment in the LTE cell.

Battelle Pacific Northwest National Laboratory (PNNL)

- Contribute post-test characterizations of samples.

Commercialization Plan

Once prototyping is completed, Northwest Aluminum Technologies intends to install this technology at one of its operating commercial facilities. Once demonstrated, NAT will make licensing available to the industry.

Project Partners

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Richland, WA

Materials Modification, Incorporated
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